**Unit 1 Cluster 1 (N.RN.1 & N.RN.2):**

**Extending Properties of Exponents**

Cluster 1: Extending properties of exponents

1.1.1 Define rational exponents and extend the properties of integer exponents to rational exponents

1.1.2 Rewrite expressions, going between rational and radical form

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| **VOCABULARY**  If the exponent on a term is of the form, where, then the number is said to have a **rational exponent.** is an example of a constant with a rational exponent. |

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| **Properties of Exponents**  (All bases are non-zero) | **Properties of Rational Exponents**  (All bases are non-zero) | **Examples** |
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|  | Students should have this property memorized. |  |
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**Practice Exercises A**

Simplify each expression using only positive exponents.

|  |  |  |
| --- | --- | --- |
| 1. | 2. | 3. |
| 4. | 5. | 6. |
| 7. | 8. | 9. |
| 10. | 11. | 12. |

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| **Definition**  A **radical** can also be written as a term with a rational exponent. For example,  where n is an integer and. In general,  where m and n are integers and.    The denominator of the rational exponent becomes the index of the radical. |

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| Rational Exponent Form | Radical Form |
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|  |  |
|  |  |

**Practice Exercises B**

Rewrite each expression in radical form

1. 

4. 

7. 

2. 

5. 

8. 

3. 

6. 

9. 

**Practice Exercises C**

Rewrite each expression with rational exponents.

1. 

4. 

7.

2. 

5. 

8.

3. 

6.

9. 

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| **Vocabulary**  For an integer *n* greater than 1, if , then *a* is the ***n*th root of *k***.  Description: http://regentsprep.org/Regents/math/algtrig/ATO3/radpic1.gif  **A radical or the principal *n*th root of *k:*** *k,* the radicand, is a real number. *n,* the index, is a positive integer greater than one. |

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| **Properties of Radicals**  **Simplifying Radicals:** Radicals that are simplified have:   * no fractions left under the radical. * no perfect power factors in the radicand, *k*. * no exponents in the radicand, *k*, greater than the index, *n*. |
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| Vocabulary  A **prime number** is a whole number greater than 1 that is only divisible by 1 and itself. In other words, a prime number has exactly two factors: 1 and itself. | Example:  *prime*  *not prime* |

Division Rules For a Few Prime Numbers

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| **A number is divisible by:** | **If:** | **Example:** |
| **2** | The last digit is even  (0, 2, 4, 6, 8) | 256 is  255 is not |
| **3** | The sum of the digits is divisible by 3 | 381 (3+8+1=12 and 12÷3=4) Yes  383 (3+8+3=14 and ) No |
| **5** | The last digit is 0 or 5 | 175 is  809 is not |
| **7** | If you double the last digit and subtract it from the rest of the number and the answer is:   * 0 * Divisible by 7 | 672 (Double 2 is 4,and ) Yes  905 (Double 5 is 10, and ) No |

Simplifying Radicals

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| **Method 1:**  **Find Perfect Squares Under the Radical**   1. Rewrite the radicand as factors that are perfect squares and factors that are not perfect squares. 2. Rewrite the radical as two separate radicals. 3. Simplify the perfect square. | **Example:** |
| **Method 2:**  **Use a Factor Tree**   1. Work with only the radicand. 2. Split the radicand into two factors. 3. Split those numbers into two factors until the number is a prime number. 4. Group the prime numbers into pairs. 5. List the number from each pair only once outside of the radicand. 6. Leave any unpaired numbers inside the radical.   Note: If you have more than one pair, multiply the numbers outside of the radical as well as the numbers left inside. | **Example:** |
| **Method 3:**  **Divide by Prime Numbers**   1. Work with only the radicand. 2. Using only prime numbers, divide each radicand until the bottom number is a prime number. 3. Group the prime numbers into pairs. 4. List the number from each pair only once outside of the radicand. 5. Leave any unpaired numbers inside the radical.   Note: If you have more than one pair, multiply the numbers outside of the radical as well as the numbers left inside. | **Example:**   |  |  | | --- | --- | | 5  5 | 75 | | 5 | 15 | |  | 3 | |
|  |  |
|  |  |
| **Method 4:**  **Use Exponent Rules** | **Example:** |
| 1. Rewrite the exponent as a rational exponent. |  |
| 1. Rewrite the radicand as factors that are perfect squares and factors that are not perfect squares. |  |
| 1. Rewrite the perfect square factors with an exponent of 2. |  |
| 1. Split up the factors, giving each the rational exponent. |  |
| 1. Simplify. |  |
| 1. Rewrite as a radical |  |
| **Method 4 with Variables:** | **Example:** |
| 1. Rewrite the exponent as a rational exponent. |  |
| 1. Rewrite the radicand as two factors. One with the highest exponent that is divisible by the root and the other factor with an exponent of what is left over. |  |
| 1. Split up the factors, giving each the rational exponent. |  |
| 1. Rewrite the exponents using exponent rules. |  |
| 1. Simplify. |  |
| 1. Rewrite as a radical |  |

**Practice D**

Simplify each radical expression.

1. 

2. 

3. 

4. 

5. 

6. 

7. 

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